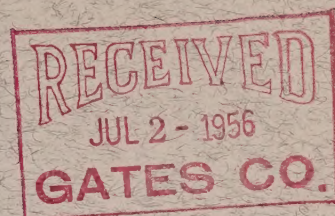


DU MONT



**SENSITIVE
AMPLIFIER-VOLTMETER
TYPE 346**

346

Allen B. Du Mont Laboratories, Inc.

TECHNICAL PRODUCTS DIVISION

760 BLOOMFIELD AVENUE, CLIFTON, N. J., U. S. A.

DUMONT

**SENSITIVE
AMPLIFIER-VOLTMETER
TYPE 346**

Operating and Maintenance Manual

Allen B. Du Mont Laboratories, Inc.

TECHNICAL PRODUCTS DIVISION

760 BLOOMFIELD AVENUE, CLIFTON, N. J., U. S. A.



FIGURE 1. TYPE 346 SENSITIVE AMPLIFIER-VOLTMETER

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SPECIFICATIONS

1. PHYSICAL

Weight—6½ pounds
Height —6½ inches
Width —4¼ inches
Depth —7½ inches

2. ELECTRICAL

VACUUM-TUBE VOLTMETER

- A. Voltage Ranges (volts rms full scale)
0.001 0.003 0.01 0.03 0.1 0.3 1 3 10 30 100 300
- B. Power Level Ranges (dbm full scale)
-60 -50 -40 -30 -20 -10 0 +10 +20
+30 +40 +50
Reference level: 1 milliwatt in 600 ohms = 0 dbm.
- C. Frequency Range
10 cycles per second to 2 megacycles.
- D. Accuracy
±3% of full scale, 20 cps to 1 mc.
±5% of full scale, 10 cps to 2 mc.
- E. Stability
±1% for line voltage changes from 105 to 130 volts.
- F. Input Impedance
10 megohms paralleled by 24 micromicrofarads.

- G. Meter Scale Marking
Linear voltage scale marked from 0 to 1.
Linear voltage scale marked from 0 to 3.
Logarithmic dbm scale marked from -12 to +2.
- H. Input Power Required
117 volts ±10%, 50 to 400 cps, 40 watts.

AMPLIFIER

- A. Gain
Approximately 1000, or 60 db, from input terminals to output jack at 0.001-volt setting of RANGE switch.
- B. Frequency Response
Useful from below 10 cps to about 4 mc. Flat within ±5% from 10 cps to 2 mc.
- C. Output Voltage
1 volt rms maximum. This voltage is approximately equal to the indicated meter reading when full-scale deflection corresponds to 1 volt output.
- D. Output Impedance
Approximately 600 ohms. Load impedance must be greater than 100,000 ohms to have no effect on the meter reading. Lower load impedances may affect the reading accuracy but will not increase distortion. Load capacitance may affect high frequency response.
- E. Input Power Required
117 volts ±10%, 50 to 400 cps, 40 watts.

DESCRIPTION

1.0 DESCRIPTION

The Du Mont Type 346 Sensitive Amplifier-voltmeter is designed to serve as a compact vacuum-tube voltmeter with the added facility of use as a wide-band amplifier. As a voltmeter, the Type 346 provides twelve voltage ranges from 0.001 to 300 volts full scale with a frequency range of 10 cycles per second to 2 megacycles. The unit is also calibrated in dbm, with a 0 dbm reference of 1 milliwatt in 600 ohms. AC power level measurements may be made from -60 to +50 dbm full scale.

The Type 346 Amplifier-voltmeter is intended for use in any applications where a highly sensitive and accurately calibrated voltage measuring instrument of this type is required. Where high accuracy is not an absolute requirement, as for null seeking, the instrument may be used at frequencies up to 4 mc and below 10 cps.

By means of a front panel phone jack connected to the output of the vacuum-tube amplifier circuit, the unit may be used as a wide-band amplifier to obtain a signal gain

up to a maximum of 1000. With high impedance loads, the meter accuracy is not affected, thereby permitting simultaneous metering. As an Amplifier, the Type 346 Amplifier-voltmeter may be used wherever a low distortion, wide-band, adjustable amplifier is required.

The circuitry of the Type 346 Sensitive Amplifier-voltmeter consists of two feedback pairs of amplifier stages in cascade applying their output to the full-wave crystal rectifier meter section. The amplifier output jack is connected to the same point in order that both may benefit from the feedback circuits.

Signal attenuation is accomplished by a RANGE switch divided into two parts, one portion operating in steps of 40 db at the input, the other portion controlling the intermediate steps and located between the two feedback pairs.

The power supply section provides the required B+ voltages through a full-wave rectifier circuit, a single section capacitor input smoothing filter, and a gas-tube regulator for all but the final plate voltage.

OPERATION

2.0 OPERATION

2.01 General

Connect the power cord to a source of 117 volts ac. Operating the power switch will turn the Type 346 Amplifier-voltmeter on, with the meter scale illumination providing the power-on indication.

CAUTION: THE MAXIMUM DC PLUS PEAK AC VOLTAGE APPLIED TO THE INPUT TERMINALS SHOULD NOT BE GREATER THAN 600 VOLTS.

Because of the high gain and high input impedance of the Type 346 Amplifier-voltmeter, open input terminals will pick up stray fields and cause a meter reading in the most sensitive ranges. The signal may cause the meter pointer to rest against the stop at the top of the scale, but no damage will result. When measurements are being made across a high-impedance source, hum or other pickup may

affect the accuracy of the reading. To avoid such effects, use shielded leads and shield the upper input terminal. Note, however, that shielding so used will increase the capacity across the source and affect the operation of the equipment being tested as well as the resultant meter reading.

When working on high impedance, high gain circuits, keep the Type 346 far enough away that the field from its power supply will not affect the circuits under test.

When the input terminals are shorted, the meter reading may differ from zero by as much as 1% of full scale due to the residual noise in the first amplifier stage. This effect is most noticeable on the 0.001-, 0.1- and 10-volt range, but the signal does not add directly to the meter reading and will not affect the accuracy of the instrument.

For greatest accuracy under all conditions, readings should be taken on the upper two thirds of the meter scale. Select ranges as necessary to provide meter deflection in this area.

2.02 Voltage Measurements

Allow the instrument to warm up briefly before using for accurate measurements.

Set the RANGE switch to the desired position for the voltage to be applied. If the voltage to be measured is unknown, set the RANGE switch to the highest position (300 volts).

After connecting the voltage to be measured, the RANGE switch can then be reduced to a convenient measurement scale. Overload protection is provided in the Type 346, but it is good practice to minimize shock to the movement and avoid causing the pointer to strike hard against the stop at the top of the scale.

Connect the input voltage to be measured to the binding posts on the front panel. The lower post is the ground terminal and is connected to the chassis of the instrument. When the Type 346 is used as a vacuum-tube voltmeter no further connections are required.

The Type 346 Voltmeter is an average-reading instrument, calibrated in rms values from a sine-wave input. Input signals containing considerable harmonic content will still provide readings on the Type 346 close to the rms values due to the circuit of the unit. The following table shows the errors in the meter readings with such input voltages. For comparison, the corresponding peak-reading meter errors usually encountered are also given.

% Harmonics	% Error Type 346	% Error
	Average-reading Meter	Peak-reading Meter
0	0	0
10 — 2nd	-0.5	-10 to +10
20 — 2nd	-2 to 0	-22 to +18
50 — 2nd	-10 to -2	-33 to +34
10 — 3rd	-4 to +4	-10 to +10
20 — 3rd	-8 to +6	-22 to +18
50 — 3rd	-20 to +4	-4 to +34

2.03 Power Level Measurements

The measurements of dbm are made in the same manner as the voltage measurements described above. In this

case, the position of the RANGE switch indicates the number of decibels to be added to the dbm meter reading. Example:

RANGE Switch Setting	-20 dbm
Meter Reading	-5 dbm
Measurement Level	$(-20) + (-5) = -25$ dbm
	referred to 1 mw in 600 ohms = 0 dbm

Although the Type 346 is calibrated for use at the reference level of 1 mw in 600 ohms (0 dbm), other references may be used when measuring the ratio of two power levels. For this purpose, the decibel reading of one may be directly subtracted from the other provided that the circuit impedances are the same for the two readings. If the impedances differ however, the power ratio in decibels may be computed according to the following formula:

$$\text{Power Ratio in db} = 20 \log_{10} \frac{\text{Voltage}(1)}{\text{Voltage}(2)} + 10 \log_{10} \frac{R(2)}{R(1)}$$

In this formula, R (1) and (2), are the resistance components associated with the Voltages (1) and (2) respectively.

2.04 Amplifier Use

When the Type 346 is to be used as an amplifier, use a phone plug to connect to the output jack. Note that the sleeve of the jack is directly grounded to the chassis.

Load impedances greater than 100,000 ohms will not affect the meter calibration, and so permits the use of the Type 346 as an amplifier and a voltmeter simultaneously. Load impedances lower than 100,000 ohms may reduce the meter measurement accuracy but will not deteriorate amplifier operation. Highly reactive loads however may affect the amplifier performance at the extremes of frequency response.

Outside of the frequency range of 10 cps to 2 mc, the gain of the amplifier will be altered to some degree by the position of the RANGE switch. In most cases, the high frequency response is about 3 db down at about 4 mc compared with the mid-frequency value.

MAINTENANCE

3.0 MAINTENANCE

3.01 General

As the Type 346 Sensitive Amplifier-voltmeter is a precision measuring instrument, it is *not* recommended that any maintenance beyond tube replacement or similar routine servicing be attempted. If the unit does not perform satisfactorily, return the instrument to the Factory Service Department for repair and adjustment.

CAUTION: THE PERFORMANCE OF THE UNIT IS AFFECTED BY THE POSITION OF SOME OF THE WIRING. DO NOT DISTURB ANY OF THE WIRING OR THE POSITION OF ANY COMPONENT.

The chassis may be removed from its case by extracting the two screws located towards the center of the back of the cover.

3.02 Tube replacement

Use any 6AK5 for replacement, but select the input tube, V1, for minimum hum and noise. Check the hum adjustment as described in Section 3.03 to follow.

3.03 Hum Adjustment

Heater-induced hum is minimized by the adjustment of the potentiometer, R41, connected across the filament circuit. When a tube is replaced, the setting of this control should be checked.

To do so, apply a voltage close to 60 cps to the instrument. Indication of excessive hum is evidenced by a noticeable beat between the input voltage and the hum.

For correct adjustment:

1. Fasten the unit chassis into its case with the screws at the rear.
2. Set the unit to the 0.1-volt or the 10-volt range and apply an input near to 60 cps. Adjust the hum control for minimum beat. The hum control is reached through an access hole in the rear of the case. See Figure 2.

Further hum reduction can sometimes be achieved by experimenting with ac power-plug reversal in the line receptacle of the Type 346 and the equipment involved.

3.04 Instrument Calibration

Equipment required: low-distortion voltage source and an accurate standard ac voltmeter.

Set the voltage source to a value, checked against the standard, that corresponds to full scale deflection in the Type 346 (e.g., 1 volt on the 1-volt scale).

With the measured voltage applied to the Type 346, adjust the calibration control until the Type 346 meter reads full scale. The calibration control is located as shown in Figure 2. No access hole is provided, the chassis must be removed from its case and the underside shielded for this adjustment.

Without changing the input voltage, check for correct meter reading on the next higher ranges.

If the Type 346 Amplifier-voltmeter cannot be calibrated by this procedure, and the tubes and crystal rectifiers check out of the circuit satisfactorily, return the instrument to the Factory Service Department for proper calibration.

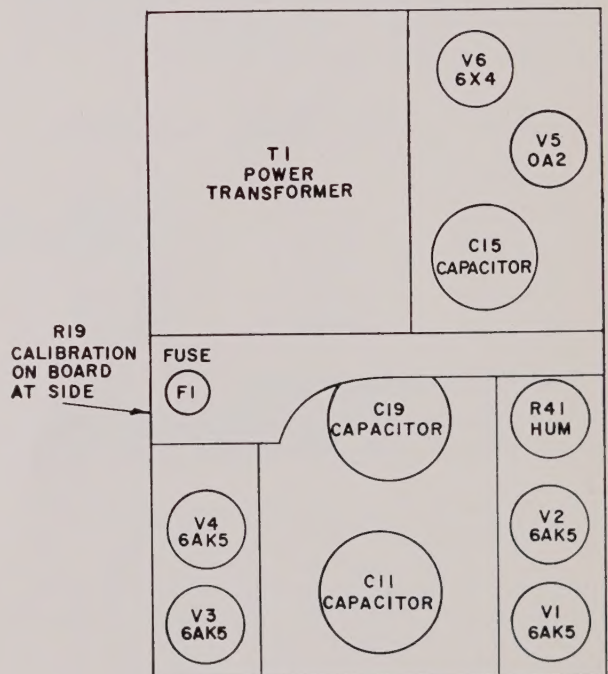


FIGURE 2. REAR VIEW TYPE 346 SENSITIVE AMPLIFIER-VOLTMETER

PARTS LIST

4.0 ELECTRICAL PARTS LIST

Symbol	Du Mont Part Number	Description
CAPACITORS		
(Fixed, paper, +100 —10% unless otherwise specified)		
C1	03012550	0.05 μ f, $\pm 20\%$, 600 V
C2 & C3	03016870	Variable, ceramic, 1.5-7 μ f, 500 V
C4	03055330	Mica, 470 μ f, $\pm 5\%$, 300 V
C5	03174551	0.047 μ f, 100 V
C6	03150430	Electrolytic, 100 μ f, +250 —10%, 3 V
C7	03138600	Electrolytic, 5 μ f, 150 V
C8	03165840	0.1 μ f, $\pm 20\%$, 200 V
C9	03138600	Electrolytic, 5 μ f, 150 V
C10	03167600	Ceramic, 4.7 μ f, $\pm 5\%$, 500 V
C11	03127440	Electrolytic, 60 $\times$ 40 $\times$ 20 $\times$ 200 μ f
C12	03150430	Electrolytic, 100 μ f, +250 —10%, 3 V
C13	03174551	0.047 μ f, 100 V
C14	03138620	Electrolytic, 15 μ f, 150 V
C15	03169670	Electrolytic, 20 $\times$ 20 μ f, 350 V
C16	03165840	0.1 μ f, $\pm 20\%$, 200 V
C17	03152050	Ceramic, 680 μ f, $\pm 20\%$, 500 V
C18	03016100	0.5 μ f, +40 —20%, 200 V
C19	03127440	Electrolytic, 60 $\times$ 40 $\times$ 20 $\times$ 200 μ f

RECTIFIERS

CR1 to CR4	26002280	Germanium crystal
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FUSE

F1	11000920	0.4 Ampere, slow blow
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METER

M1	28002081 or 28002111	0-1 ma movement
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RESISTORS

(Fixed, composition, $\pm 10\%$, $\frac{1}{2}$ W unless otherwise specified)		
R1	02243920	Film, 101K ohms, $\pm 1\%$
R2	02236740	Film, 1K ohms, $\pm 1\%$
R3	02032250	10M ohms
R4	02244390	Film, 10M ohms, $\pm 1\%$
R5 & R6	02100750	Wire Wound, 2.7 ohms
R7	02031680	180 ohms
R8	02241200	Film, 100 ohms, $\pm 5\%$
R9	02031940	27K ohms
R10	02241460	Film, 10K ohms, $\pm 5\%$
R11	02032130	1M ohms

Symbol	Du Mont Part Number	Description
R12	02034920	18K ohms, 1 W
R13	02031680	180 ohms
R14	02034870	6800 ohms, 1 W
R15	02031780	1200 ohms
R16	02031650	100 ohms
R17	02110820	Wire Wound, 1K ohms, $\pm 5\%$, 5 W
R18	02241210	Film, 130 ohms, $\pm 5\%$
R19	01053300	Variable, Wire Wound, 100 ohms, $\pm 20\%$, 1.5 W
R20	02241200	Film, 100 ohms, $\pm 5\%$
R21	02243440	Film, 750 ohms, $\pm 1\%$
R22	02030170	51 ohms, $\pm 5\%$
R23	02236890	Film, 4700 ohms, $\pm 1\%$
R24	02236770	Film, 1500 ohms, $\pm 1\%$
R25	02236700	Film, 470 ohms, $\pm 1\%$
R26	02243410	Film, 220 ohms, $\pm 1\%$
R27	02031780	1200 ohms
R28	02032110	680K ohms
R29	02031940	27K ohms
R30	02034920	18K ohms, 1 W
R31	02032130	1M ohms
R32	02031730	470 ohms
R33 & R34	02031740	560 ohms
R35	02031730	470 ohms
R36	02031780	1200 ohms
R37	02031730	470 ohms
R38	02031940	27K ohms
R39	02037940	27K ohms, 2 W
R40	02110820	Wire Wound, 1K ohms, $\pm 5\%$, 5 W
R41	01070310	Variable, Wire Wound, 100 ohms, 2 W

SWITCHES

S1	05011081	Rotary, Range
S2	05001130	Toggle, Power

TRANSFORMER

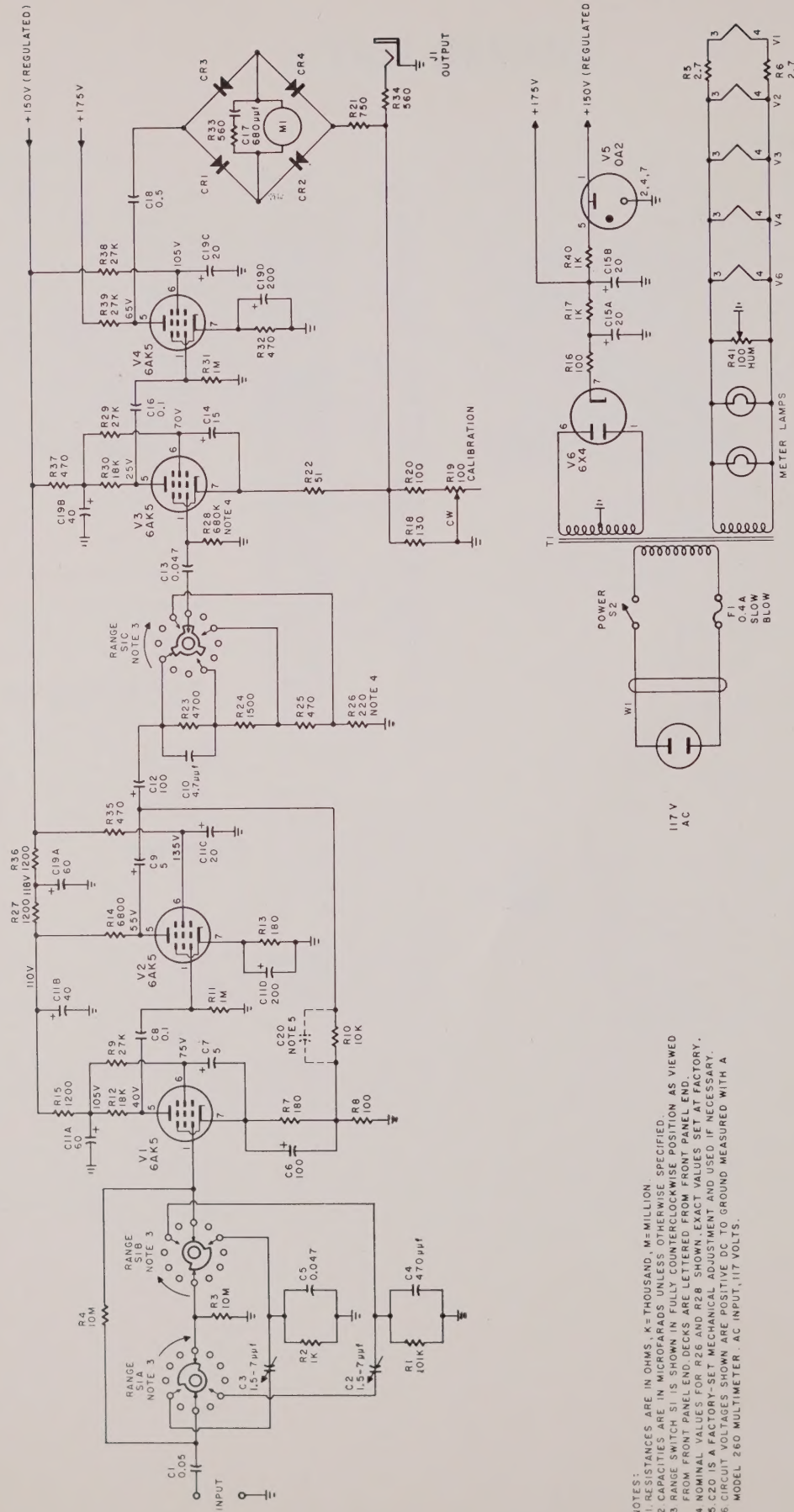
T1	20010411	Power
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TUBES

V1 to V4	25000180	6AK5
V5	25000300	0A2
V6	25000170	6X4

CABLE

W1	50135710	AC Power Cord
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SCHEMATIC OF CIRCUITS
DUMONT TYPE 346 SENSITIVE AMPLIFIER-VOLTMETER
Reference Drawing No. 98001131-4, Issue 2

WARRANTY AND SERVICE NOTICE

for

Industrial Type Cathode-ray Tubes and Instruments

DU MONT INSTRUMENTS

Each instrument manufactured by the Technical Products Division of Allen B. Du Mont Laboratories, Inc., is guaranteed to equal or exceed its published performance specifications. It is further guaranteed against defective materials (other than the cathode-ray tube) and workmanship for a period of one year from delivery date. Any defective instrument or an instrument that does not meet or exceed our specifications will, upon inspection by us, be repaired or replaced at our discretion should such defect appear within the guarantee period.

To register this guarantee, the enclosed guarantee card must be properly filled out and mailed to the factory immediately upon receipt of the equipment. Complete information is necessary. **BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD.**

Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

DU MONT CATHODE-RAY TUBES

Industrial type cathode-ray tubes manufactured by Allen B. Du Mont Laboratories, Inc., are guaranteed for 1000 hours of operation or for a six-month period from date of shipment, whichever expires first. Adjustments will be made on the merit of each individual claim because of the widely varying applications to which such tubes are subjected, and a tube which becomes defective during the guarantee period will be replaced **ONLY AFTER INSPECTION AT THE FACTORY.** Cathode-ray tubes returned under the guarantee, must be shipped with transportation paid.

BURNED-OUT HEATERS AND BROKEN GLASS ARE NOT COVERED BY THE TUBE GUARANTEE

To register a tube guarantee, the guarantee card enclosed with the tube must be filled out properly and mailed to the factory immediately upon receipt of the equipment. Complete information is necessary. **TYPE NUMBER AND SERIAL NUMBER OF THE CATHODE-RAY TUBE MUST BE INCLUDED.** The serial number of the tube will be found either on the glass stem of the electron-gun structure or on the bulb near the Du Mont brand. Tubes

must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

SERVICE

In order to insure factory service under our guarantees, the guarantee cards enclosed with all instruments and tubes must be properly filled out and returned. In all cases where service or adjustment is requested, please write first to the factory giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. **THE TYPE NUMBER AND SERIAL NUMBER** of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing in this respect, address:

Allen B. Du Mont Laboratories, Inc.

Technical Products Division

760 Bloomfield Avenue, Clifton, New Jersey

The Technical Products Division will then send to the customer, the written procedure for sending the instrument back to the factory. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

REPLACEMENT PARTS

If it is necessary to order a replacement component from the factory, always give the type number and serial number of the instrument and refer to the component by its symbol designation and description on the circuit schematic. This will help to expedite service.

DU MONT

Additional copies of this manual may be secured at a cost of fifty cents each or five dollars per dozen copies; postpaid in the United States of America only.

Allen B. DuMont Laboratories, Inc.

TECHNICAL PRODUCTS DIVISION

760 BLOOMFIELD AVENUE, CLIFTON, NEW JERSEY